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THE MOUNTAINS OF SOUTHERNMOST AFRICA.

BY

W. M. DAVIS.

The British Association in South Africa.—In August and September, 1905, when the British Association for the Advancement of Science held its meeting in the Colonies of South Africa, I had opportunity as one of the guests of the Association to see something of the chief physiographic features of the region we traversed; and as our excursions were always guided by local experts, for whose competence we gained the highest respect, it was possible for us, even in the brief period of thirty-three days between arriving at Cape Town and sailing from Beira (Portuguese East Africa), to gain a good general understanding of several leading problems. We were much aided in this by the excellent books lately published on the geology of the Southern Colonies—one by A. W. Rogers, Director of the Geological Survey of Cape Colony, on the district under his charge; the other by Messrs. Hatch and Corstorphine on the "Geology of South Africa;" as well as by the excellent handbook, "Science in South Africa," prepared by various writers especially for the Association meeting. It is my desire to present here a brief statement concerning one of the most significant and well defined of the physiographic areas that we traversed—namely, the east-and-west mountain system, which occupies the southernmost border of Africa. It is true that we passed through only the western end of these mountains; but their structure seems to be so regular that a fair appreciation of the whole may be acquired from the study of this characteristic sample. No name appears to be current for this mountain system; it will be here referred to under the name of the Cape Colony ranges.

The Cape Colony Ranges.—The ranges of this mountain system occupy the southern border of South Africa for a width of sixty or

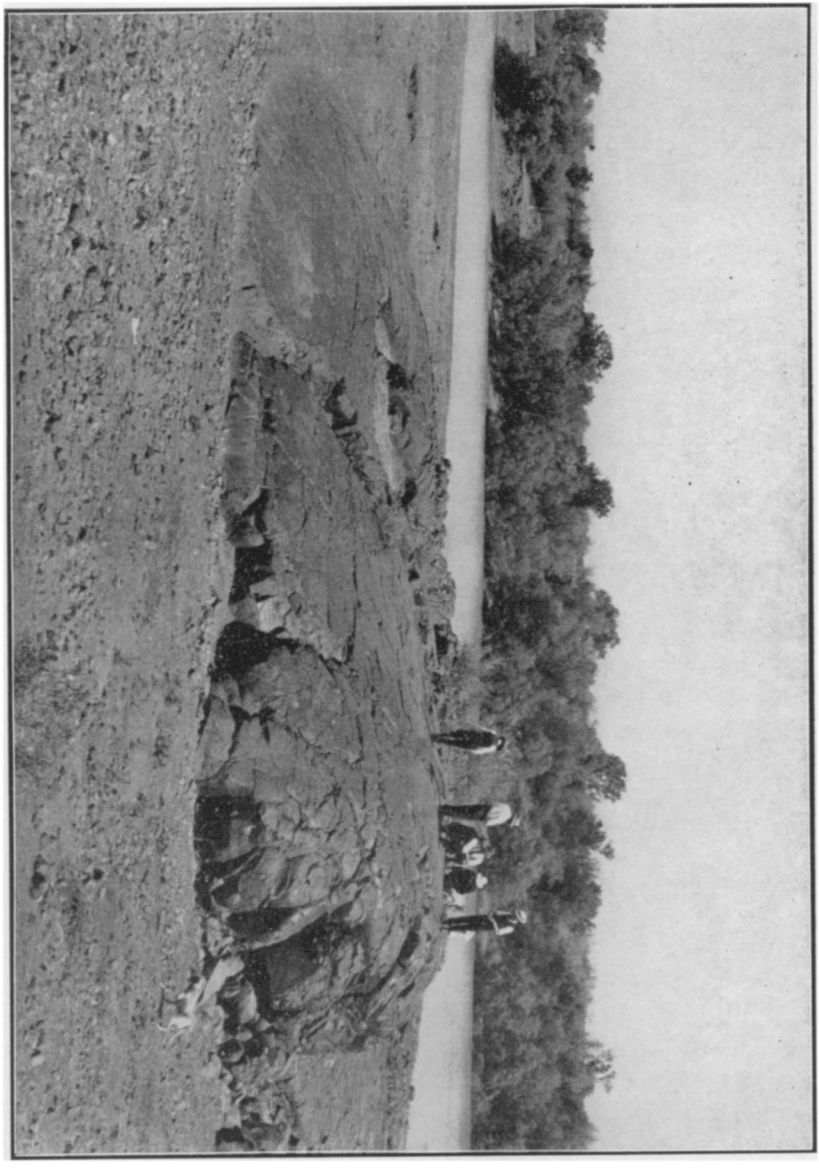


FIG. 1.—A LEDGE OF DIABASE, ON THE VAAL RIVER, NEAR KIMBERLEY, ROUNDED BY DWYKA (PERMIAN) GLACIATION.

eighty miles and a length of 350 or 400 miles. (See map, Fig. 13.) They include a number of sub-parallel, east-and-west ridges,

separated by longitudinal valleys. Near the southwestern corner of the continent the east-and-west ridges are replaced by narrower and less continuous north-and-south ridges, with broad and frequently confluent lowlands between them. Table mountain range is one of the north-and-south group, with Cape Town at its northern end and Cape of Good Hope at its southern end; it seems as if this range might have been an island but for a broad belt of sandy flats on its eastern side, with Table bay on the north and False bay on the south, by which it is attached to the mainland. It is a matter of interest to note that Ras Hafun, a small peninsula of Somaliland, which we saw on the voyage home, and which instead of Cape Guardafui (as usually stated) makes the easternmost point of Africa, is another example of the Gibraltar-like tied-on islands.

It is significant that the southern coast of Africa is not parallel to the ridges of its mountain system. From Cape Hanglip, which encloses False bay on the east, to Cape Agulhas, the coast trends southeast, breaking irregularly across several short ridges. Cape Agulhas, making the southernmost point of the continent, seems to be but a short fragment of one of the east-and-west ridges. Then, turning eastward, Cape Agulhas is seen to be the first one of six east-and-west ridges which are cut off by the oblique east-northeast trend of the southern coast, with the result of making a series of northward offsets in the shore-line as each ridge is passed. We were told that these offsets were just so many disappointments to the early navigators, who thought that the eastern coast of Africa would be reached as each offset was rounded, and who had repeatedly to turn eastward again after making a little northing, before the homeward half of their circumnavigation was well begun.

The manner in which the successive ridges end in the sea at the coastwise offsets leaves no doubt that the present Cape Colony ranges are only a large remnant of the whole mountain system that was once formed there. The rest of the system has been consumed by the sea, or drowned beneath it by depression.

Comparison of the Cape Colony Ranges and the Alleghenies.—The Cape Colony ranges present a number of features that are of special interest to American geologists and geographers, because of the singularly faithful recurrence far away in the other hemisphere of features familiar to us at home in the Allegheny mountains of Pennsylvania and Virginia. The strata involved in both cases are Paleozoic, but include in South Africa also some Mesozoic formations, and were originally spread out in layers of much uniformity horizontally, but of marked diversity vertically. In South Africa, the

strata include the heavy Table mountain sandstones, 4,000 or 5,000 feet thick, practically barren of fossils and supposed to be of non-marine origin; the Bokkeveld ("Goat-pasture") series, about 2,500 feet thick, containing marine Devonian fossils; and the Witteberg quartzitic sandstones, with some shaly sandstones, 2,500 feet thick, practically barren of fossils and possibly of non-marine origin. These three formations, 10,000 feet in total thickness, are grouped together to constitute the Cape system. The floor on which this system rests is well seen in the Table mountain range, in the neighbourhood of Cape Town, where it is found to be an ancient peneplain, truncating the greatly-disturbed Malmesbury slates and intrusive granites, supposed to be of Archæan date. The Cape system is followed by the Karroo system, apparently 20,000 feet in total thickness: the first member is the famous Dwyka glacial formation, which lies in part of its area unconformably on well-glaciated ledges of older rocks (Fig. 1), and elsewhere conformably on the Witteberg shales; where best developed, it consists of interbedded sheets of consolidated till (for which Penck has proposed the name of tillite) and well-stratified shales, to a thickness of a good 1,000 feet; this being followed by the Ecca, Beaufort, and Stormberg formations, containing coal beds and fossils of land animals, and thus indicating a prevalence of continental conditions in the Karroo as well as in the Cape system. It is true that continental formations are exceptional in the Appalachians; but there, as well as in South Africa, the strata which were later crushed into mountain folds were deposited on what seems to have been a peneplain of still older rocks; and in both cases the great thickness of the accumulated strata was made possible by the slow depression of the area of deposition. It is well to bear in mind, when deformations of the earth's crust are under consideration, that the deep burial of old peneplains like those here concerned involves the down-sinking of a crustal surface from near sea-level to a considerable depth.

In the Appalachians, as well as in South Africa, forces of compression have crowded part of the area occupied by these heavy Paleozoic formations into long sub-parallel corrugations, with overturns and overthrusts directed towards what is to-day—and what has presumably long been—the continental centre; but in both regions the formations concerned were left essentially horizontal over an adjoining inner area, which constitutes the Allegheny plateau in the United States and the highland of the Veld in South Africa, as illustrated with undue regularity of structure

in Fig. 2. From this it is to be inferred that the tangential thrust by which the compression and overturning were produced was in both cases directed from the region that is now the ocean towards the region that is now the land—that is, from southeast to northwest in the eastern United States, from south to north in South Africa. This analogy suggests another, for which the facts observed at present give permission without strong support—namely, that as the chief source of the sediments was on the ocean side of the existing ranges in the Appalachians, where the Paleozoic land area is recognizable in the belt of older crystalline rocks, a similar relation may have obtained in South Africa; but there the inferred older rocks are not visible now along the southern coast, and some evidence has been adduced to show that the source of the sediments lay inland to the northwest. It still, however, seems worth while to bear this analogy in mind; and all the more because

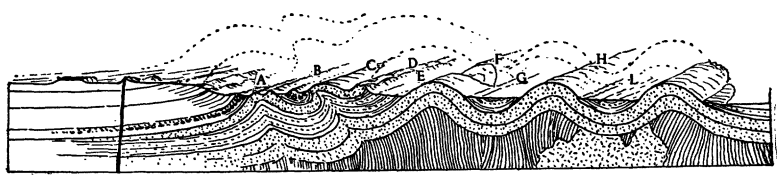


FIG. 2.—GENERALIZED SECTION ACROSS THE COLONY RANGES.

the present southern coast of Africa has manifestly been much encroached upon by the sea. The existence of an ancient land in what is now the Southern Ocean is therefore an open possibility.

The relation of the folded belt to the unfolded highland has been explained by some South African writers as showing the work of compression against "the solid and immobile mass of the Karroo rocks" in the Veld. This gives too great credit for resistance to so much of the Karroo formation as still lies essentially horizontal. Before the folded belt was corrugated it must have looked just as solid as the Veld looks to-day. The limitation of the Cape Colony corrugations, like the limitation of the Allegheny corrugations, is better explained by the exhaustion or the satisfaction of the compressing forces, rather than by any special resistance in the area where the same strata as those of the folded belt still lie horizontal.

Two Cycles of Erosion.—Both of these mountain systems have been vastly eroded since they were formed, but the ranges that we see are in no proper sense merely the unconsumed residuals of the original uplifts. There is much reason to think that in both re-

gions the relief due to initial deformation was practically destroyed in a long cycle of erosion, the up-arched ranges being then reduced to the small relief of a peneplain. It may be noted briefly that the best evidence for this conclusion, in so far as the Cape Colony ranges are to-day known, is found, not in their own area, but in the area of the Veld to the north. There the highland plains (Fig. 3) are demonstrably not plains of original construction, but plains of penultimate or even ultimate degradation; for they are frequently surmounted by residual hills and mesas of more resistant rocks, whose former greater extension over the plains of to-day

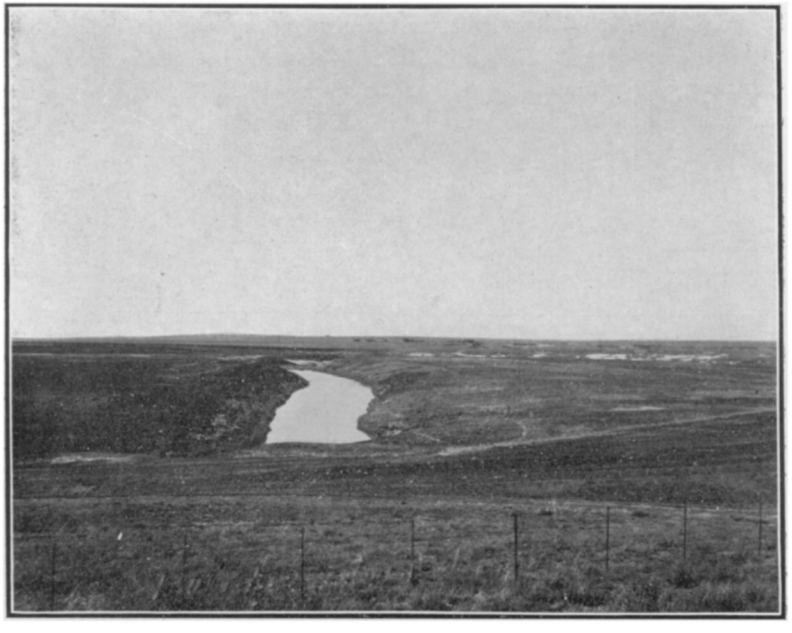


FIG. 3.—THE VELD.

is undoubted. The resistant rocks are chiefly dolerites, which occur in the form of dikes and sheets over a large part of the highland area; where heaviest the dolerite sheets form the Stormberg and Drakensberg mountains, which now constitute part of the divide between the long and leisurely westward descent of the Orange river headwaters and the more rapid southeastward descent of shorter streams to the Indian Ocean.

The openness of the greatest part of the Veld has had a marked influence on the settlement of the country. In the earliest days it made exploration by the vanguard, "the frontiersmen," of the

Boers very easy, after once the ascent of the highland was accomplished; shortly afterward, at the time of the Great Trek in 1836, it permitted the entrance of families and, indeed, of communities, bringing all their household goods in wagons—for much of the Veld is so flat and so free from vegetation that ox-teams can draw heavy loads over it in any direction for miles together. In later years the same openness has greatly facilitated the construction of railway lines, which have now attained an important development, though the traveller must often marvel, as he does on the Great

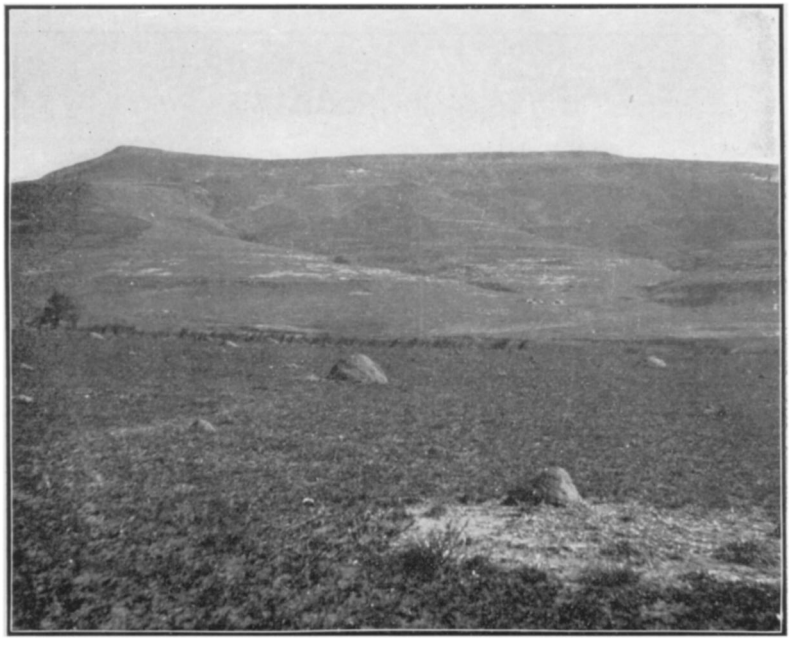


FIG. 4.—HLOBANI.

Plains of the United States, which the Veld in so many ways resembles, how it is possible to make a railway line pay where distances are so great and where people are relatively so few.

The ridges and mesas of the Veld, mostly of dolerite, are likewise of geographical significance. They are deserts, as far as human habitation is concerned, for their surface is stony and barren; but they afford excellent points of view from which routes of travel can be laid out for many miles in advance, and they have been repeatedly held as points of vantage in warfare by Zulus, Boers, and British. Some of the hills have thus become famous; witness Hlobani and

Majuba, shown in Figures 4 and 5. Where the dolerite sheets lie but little above the general level of the plain their barren, rocky surface, strewn with loose boulders of disintegration, is very unlike the smooth surface that has been worn down on the shales which underlie most of the Veld. The chief obstacle in the way of travel on the highland is presented, not so much by the ridges as by the rivers, which at time of high water are impassable except where the few bridges have been built, and which at time of low water are to be crossed by fording at some point where the high banks of the channels are sloping enough to haul a wagon.



FIG. 5.—MAJUBA HILL.

It is noteworthy that the southern boundary of the area of dolerite intrusion lies a little north and closely parallel to the border of the corrugated belt, and that the date of the intrusions is about the same as that of the corrugations. It is, therefore, permissible to suppose that both the corrugation and the intrusion—or the ascent of igneous rock from its deep source—were the results of the same force, and that here as in various other regions the first cause of the ascent of igneous rock may be due to simple squeezing, however large a share of final eruption

may be due to the explosive action of included gases when the ascending rock approaches the surface. In this connection it may be mentioned that in the Kimberley diamond district one of the necks occupied by the greatly-weathered peridotite or "kimberlite" has been completely excavated to a depth of over 1,500 feet (Fig. 6),

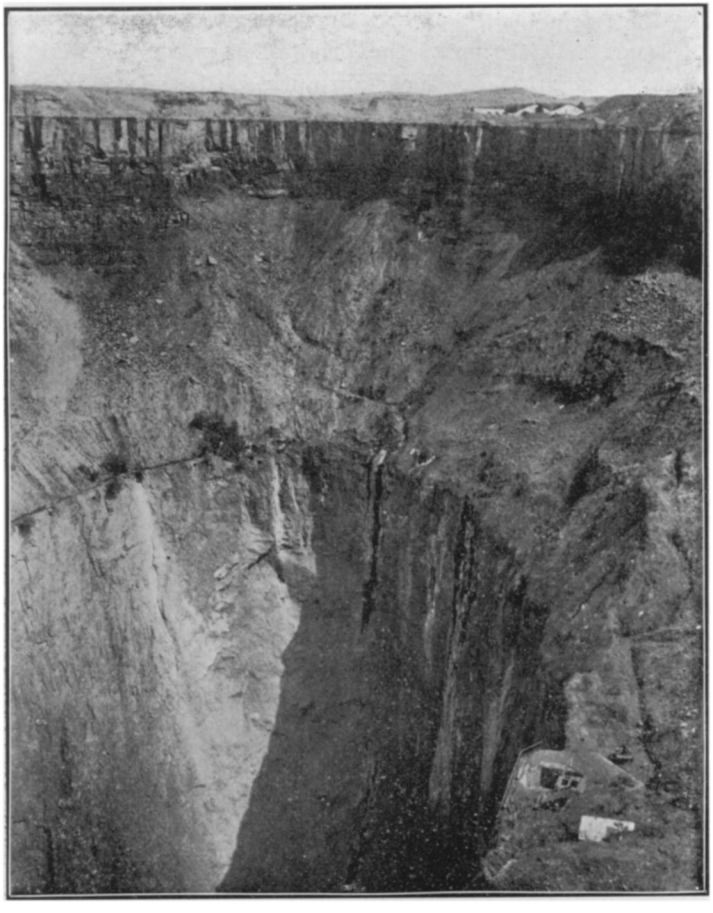


FIG. 6.—THE KIMBERLEY MINE.

with the result of showing that the necks unquestionably occupy tube-like pipes, however difficult it may be to explain their origin.

Farther north, about Bulawayo in Rhodesia, the peneplain is worn down on disordered schists, locally surmounted by curious knobs of weathered granite, called Matopos (Fig. 7); they have practically the appearance of great boulder heaps. Some of the

non-geological members of the excursion party suggested that the boulders might be of glacial origin; but they are without question simply decaying masses of granite. The rounded form of the boulders is due merely to the action of the weather, flaking off the corners and edges of joint blocks.

It is in the highest degree probable that the same period of time which sufficed for the great erosion of the Veld sufficed also for the wholesale destruction of the originally up-folded ranges next south. Besides this there are certain uplands, described by Schwarz and others, among the southern ranges where the surface is dis-

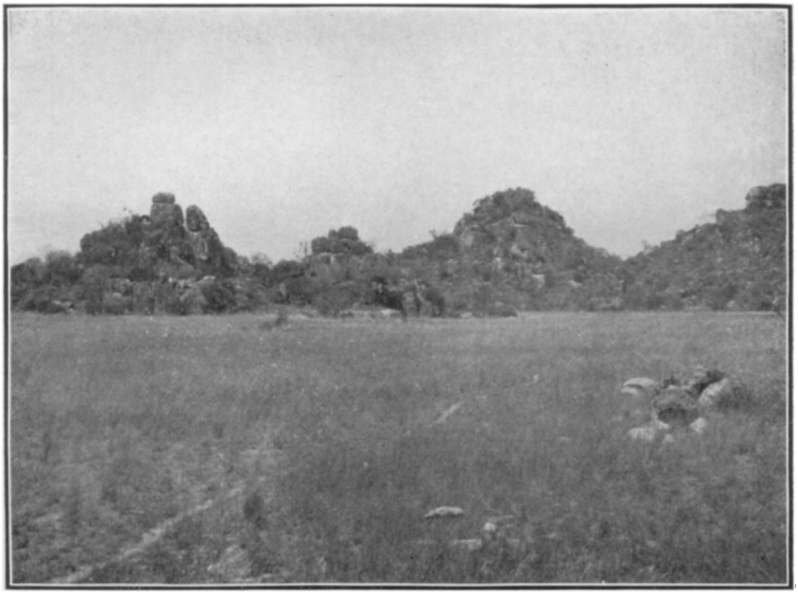


FIG. 7.—MATOPOS.

tinctly bevelled across the strata; and these go far to confirm the inference based on the history of the Veld.

As a result of this long cycle of erosion the heavy formations of the Karroo system have been almost entirely removed from the area of the Cape Colony ranges, although they still stretch far and wide over the Veld; just as the Carboniferous strata have been largely removed from the area of the folded Appalachians, although they still stretch broadly over the adjoining area of the Allegheny plateau. The evidence of the former greater extension of the now eroded members is the same in both cases; they are believed to have stretched over most of the folded area, because they are

still preserved there wherever deep synclinal folding kept them at a low level, and so prevented their removal by erosion.

Since the advanced erosion or partial peneplanation of the folded ranges took place the renewal of deep erosion shows that the land has taken a new attitude with respect to the circumjacent seas. In the case of the Appalachians it is generally agreed that the new attitude of the land was caused by a broad up-arching of the mountain belt; in the case of the certain parts of South Africa which, along with Cape Colony ranges and the highland of the Veld, are to-day suffering a deeper dissection than was once possible, it has been suggested that the new attitude of the land with respect to the sea was not the result of an uplift of the present land area, but of a depression of an adjoining area of former higher border lands. The submergence of such border lands would bring the sea closer in towards what was formerly an interior highland; and in this way the drainage of the formerly-enclosed interior highland might have been diverted to the shores of an encroaching sea. This would result in the dissection of the highland just as effectually as if it had been directly elevated. The question here outlined is more fully discussed in a paper offered to the Geological Society of America, with the conclusion that South Africa has been diminished in area by the submergence of former border lands on the east, south, and west, and that it has probably been elevated since the peneplanation of the Veld and the great erosion of the mountain belt.

However all this may be ultimately settled, the effects of the later cycle of erosion that was introduced in consequence of the new attitude of the South Africa with respect to sea-level and sea margin are of as essential importance in describing the present form of the Cape Colony ranges as in treating that of the Appalachians. In the new cycle of erosion, longitudinal valleys and lowland belts have been excavated along the bands of weaker strata, thus leaving the more resistant strata standing up in residual ridges. The ridges of both these mountain systems are, therefore, due to "circumdenudation." It gives a wrong idea to say that the ranges are "true mountains, produced by the earth's crust being thrown into upward folds from the south and west." They are certainly true mountains; but, as we shall see, they are much more the result of differential erosion than of differential elevation.

In some of the accounts of these ranges, surprise has been expressed that certain of the anticlines have not been more con-

sumed; and it is added that "a satisfactory explanation of this question has not yet been found." Precisely the same difficulty has been felt by some observers in the Alleghenies, where certain folds are greatly eroded and others are almost intact. I venture to suggest that a sufficient explanation for this apparent difficulty is found in the conception of two cycles of erosion. All the structures, whether of strong or of weak strata, that rose effectively above the baselevel of the first cycle, have been enormously worn away; while the hard structures that lay below the earlier baselevel have not yet been much consumed by erosion in the second cycle with respect to the lower baselevel.

The Adjusted Drainage System.—There is every reason to think that the drainage of folded mountain ranges in the early stages of their history must be in greatest part consequent on the forms produced by the folding: longitudinal consequent streams should follow the synclinal troughs, and lateral consequent branches would descend to them from the anticlinal arches. Such is, in essence, still the pattern of drainage prevalent in the Jura mountains, whose erosional history is relatively simple, even though it may involve more erosion than has generally heen supposed. The ranges here considered have drainage systems of a very different kind. A notable result of the great work of erosion in both the Allegheny and the Cape Colony mountains is the development of numerous subsequent valleys which had no foreshadowing in the topography that was consequent on the original folding of the region. Subsequent valleys are those which have been formed by the headward erosion of out-growing branches of lateral consequent streams along the various belts of weak internal structure; for weak structural belts must be repeatedly laid bare on the sides of the lateral consequent valleys, as they were worn deeper and deeper into the flanks of the original anticlinal arches. As a result of all this, the relief and the drainage of these worn-down and re-dissected ranges repeatedly departs from the simple consequent pattern of early youth, and exhibits instead a peculiar adjustment of streams to weak structures and of divides to hard structures which is one of the strongest witnesses to the truth of the doctrine of uniformitarianism; for in no other imaginable manner than by the long and patient seeking of erosive processes could such an adjustment be brought about. Neither the ridges nor the valleys of to-day hold any close relation to the uplifts and (relative) depressions of the time of deformation. However definitely the relief and the drainage may have at first depended on the form originally initiated

by deformation, they have slowly given way to a system of adjusted relief and drainage, in which subsequent divides and subsequent streams are of the greatest importance. Examples of ridges and valleys which illustrate these fundamental principles of mountain sculpture are well known in the Alleghenies; we saw several equally good examples among the Cape Colony ranges, and the descriptions and maps of other districts than those which we crossed lead us to believe that the whole of this far southern mountain system is thus characterized.

One of the best examples of a subsequent lowland belt that we



FIG. 8.—MATJESFONTEIN.

saw was a valley south of Laingsburg which has been eroded along the relatively weak strata of the Bokkeveld series, *E* (Fig. 2), on the side of a huge anticline, while to the south the axial core of the anticline (*F*) rises in the Klein Zwartberg of resistant Table mountain sandstone; and to the north rises the Witteberg range, *D*, *C*, determined by a wrinkled monocline of hard sandstones. Another excellent example of a subsequent valley is the lowland of the Karroo, or dry country, between the innermost of the Cape Colony ridges—the Witteberg range (Fig. 8), just mentioned—and the south-facing escarpment of the Veld on the north. This low-

land belt, *A*, to-day followed by longitudinal streams, was originally a great north-falling slope, where the surface of deformation would have descended from the northernmost of the great mountain folds toward the relatively undisturbed area of the plateau. The counterpart of the Karroo lowland is found in Pennsylvania; one part of it is known as Bald Eagle valley, running from Tyrone to Williamsport; it has been eroded, just as the lowland belt of the Karroo has been, along the weak monoclinal strata that lie between the resistant sandstones on the flank of the innermost anticline and the still horizontal strata of the Allegheny plateau.

Consequent and Resequent Valleys.—Correlated with the development of important subsequent valleys on the flanks of the great original anticlines is the frequent abandonment of the original synclines by the chief rivers. The changes here considered are illustrated in the four stages of Fig. 9. If a deep synclinal fold is occupied by weak strata, from above which no hard strata have been eroded, it may still be followed by a good-sized river, as at *B* (Fig. 9), between anticlines of harder strata, even though much of the lateral consequent drainage originally tributary to it is now intercepted by longitudinal subsequent streams, *F*, *S*, which have been developed in weak strata that underlie the anticlinal arch; but if, as not infrequently happens, the strata now found along a synclinal axis are relatively resistant, as in Stage 3 of Fig. 9, they may stand up in a ridge of greater or less relief, at at *C*, and all the drainage of the original synclinal river may then flow by obsequent streams to neighbouring subsequent valleys, *N*, *P*; the obsequents being those branches of the subsequents that flow against the direction of the dip of the strata, and therefore opposite to the direction of the lateral consequents which they replace. Not only so: some of the streams that follow longitudinal synclinal courses in a deeply-eroded mountain range, as if they were genuine persistent consequents, are in reality of a more complicated origin. Consider an example in which the weak strata now followed by such streams—as at *D* in Stage 4 of Fig. 9—were not originally the "top of the heap," but were buried at time deformation by several thousand feet of overlying strata, some of which were of a considerable resistance. During the erosion of the region, the down-bent axial part of these resistant strata would for a time assume the form of a synclinal ridge, *C*, and the original synclinal stream would then be replaced by two subsequent streams, *N*, *P*, in neighbouring longitudinal valleys; but this stage of topographic evolution would be followed later by the complete removal of the synclinal ridge and

the excavation of a new longitudinal synclinal valley on the deeper weak strata, as at *D* in Stage 4; and in this new-eroded valley the two subsequent streams, *N*, *P*, would have coalesced to form a single axial synclinal stream. A good example of this kind was seen in a small syncline in the Witteberg range south of Laingsburg (between *C* and *D*, Fig. 2), where the valley on the weak (upper) Witteberg shales is enclosed by ridges of the stronger (lower) Witteberg sandstones on either side. Various alternately hard and soft strata of the overlying Dwyka and Ecca series must have once occupied this syncline; and during their erosion the axis of the syncline has, with little doubt, alternately assumed the form of a ridge and of a valley, according as its surface was successively occupied by strong or weak strata. Indeed, a short ridge of Dwyka tillite

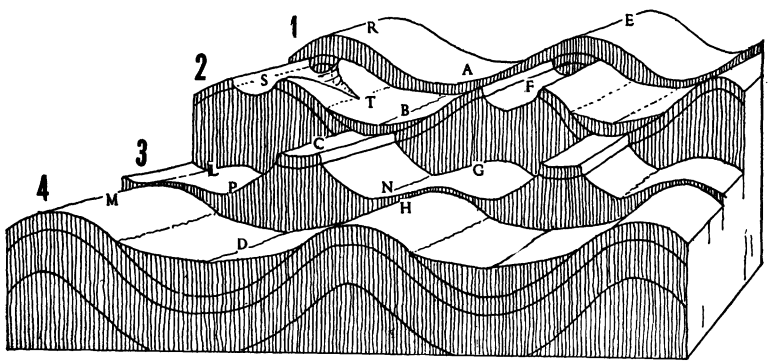


FIG. 9.—DIAGRAM OF FOUR STAGES OF EROSION IN FOLDED STRATA.

still stands in one part of the valley, east of the point where Buffels river comes into it from a deep gorge in the enclosing Witteberg range on the north; and on either side of the little Dwyka synclinal ridge there is a subsequent monoclinal valley; but where the Dwyka tillite has been completely worn away the syncline is occupied by a single valley and drained by a single stream. Plentiful examples of this kind of stream development are known in Pennsylvania.

It is evidently inappropriate, in the interests of a precise terminology, to call a stream, which has after various transformations come again to flow along a synclinal axis, by the same name that is given to a stream which has never deserted such a location; nevertheless the close relation between the two streams should be expressed by an appropriate similarity of names. In view of this, I suggested a few years ago that streams which, after spontaneous development aside from an original consequent course, come again

to follow it, should be called *resequent* streams. The name will have little interest for those to whom all streams are alike; but it will, I hope, serve a useful purpose in the work of those who find an elaborated terminology useful in so far as it aids to distinguish the varieties of natural facts.

Anticlinal Ridges.—The general principle that long-continued erosion will result in the survival of ridges along the belts of harder strata, while the valleys are excavated along belts of weaker strata, irrespective of the original forms produced by deformation, is well illustrated in the Cape Colony ranges; nevertheless the fact that all the chief east-and-west ridges are anticlines of Table mountain sandstone gives the impression that these ridges at least are directly consequent upon the initial folding of the region, however much the valleys may now depart from their original synclinal location. But there is good reason for thinking that the high anticlinal ridges are not immediately inherited from the original uplifts, and that they really are resequent ridges, and not consequent ridges. This will appear from a further reference to Fig. 9, where it is seen that in the erosion of a folded series of hard and soft strata, an original anticline, *E* or *R*, may be for a time converted into an anticlinal valley, *F* or *S*, of weak strata, in the floor of which may later appear the crown of another hard-rock anticline, *G* or *L*, and this may still later, when the weak strata are worn from its flanks, come to stand up in strong relief, *H* or *M*, directly underneath the lost anticlinal ridge of the original folding. Such an anticlinal ridge ought not to be called a consequent ridge, for it is not an immediate successor of the originally up-folded anticlinal ridge; but it so closely repeats the form of the original folding that it may well be called a resequent ridge. Similarly, the streams that run down its side slopes are not properly called lateral consequents. That name is appropriately given to the streams on the original folded surface —if such a surface ever existed—and to their immediate successors; but already in the second stage of erosion indicated in Fig. 9, the lateral consequents have lost their heads (except for an occasional surviving member, as at *T*, which notches the anticlinal slope and drains the axial subsequent valley, *S*; but even these survivors disappear in the later stages of erosion); in the third stage they are almost extinguished, while a new series of similar streams —lateral resequents—is beginning to be developed on the crown of the then newly-uncovered hard-rock anticlines, *G* and *L*; finally, in the fourth stage of erosion, which represents fairly well the present

condition of the Cape Colony ranges, the original lateral consequents have disappeared entirely, and their places are well taken by the prolonged lateral resequents, which now join a longitudinal resequent on the axis of a resequent synclinal valley.

Klein Zwartberg, *F* (Fig. 2), appeared to be an admirable example of a resequent anticlinal ridge, as thus explained. We saw it from a knob of a monoclinal Witteberg range, *D*, across the broad subsequent lowland of Bokkeveld beds, *E*, some ten or fifteen miles wide; the crest of the great anticline of Table mountain sandstones rose in most of its visible length to a remarkably even sky-

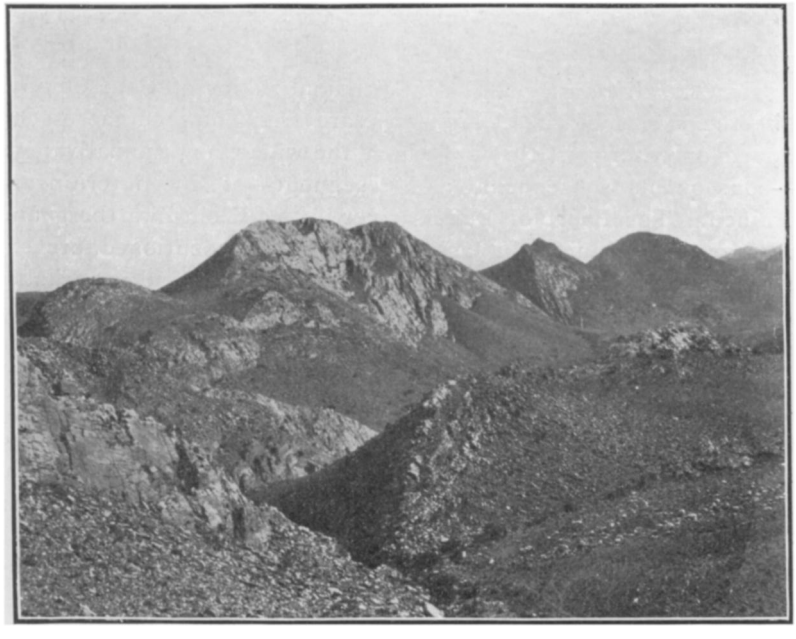


FIG. 10.—A RIDGE IN THE WITTEBERG.

line, deeply trenched at one point, where Buffels river has cut a superb Poort or notch; the bare, rocky side slopes being gulleyed to a moderate depth here and there by lateral resequent streams. It is eminently possible that an anticlinal valley, eroded on the weak Bokkeveld strata, existed directly above site of the Zwartberg during a late stage in the earlier cycle of erosion, and that ridges of Witteberg sandstone then existed over the site of the present Bokkeveld valleys.

As in the anticlinal ridges of Medina sandstone in the Alleghenies, for example, Jacks mountain south of the Juniata gap at

Mapleton, the evenness of the crest-line of the Klein Zwartberg need not be taken as an indication of truncation by former base-levelling; for in both these almost identical cases the evenness of the crest is simply enough explained as the result of stripping away the weak overlying strata from the top of an evenly-folded arch. It is natural, therefore, that the east-and-west Cape Colony ranges should, like the Alleghenies, be devoid of isolated and dominating peaks. Regularity of crest-line is the rule; but certain monoclinal ridges of intermediate strength, such as that of the Witteberg sandstone (Fig. 10), next north of Klein Zwartberg, are cut into knobs by obsequent ravines. Abundant examples of similar "comby ridges" are found in the monoclines of the Alleghenies.

Poorts or Watergaps.—The longitudinal ridges of Cape Colony, like the ridges of the Alleghenies, are frequently cut across by Poorts or watergaps, through which the wider longitudinal valleys —consequent, subsequent, and resequent—of the interior are drained. The Poort of Buffels river in the Klein Zwartberg and the gap of the Juniata in Jacks mountain, just mentioned, are excellent examples of this class of forms. Here we find remarkably fine illustrations of the manner in which a belt of resistant strata may maintain steep walls enclosing a narrow valley, during a stage of regional development in which the belts of weaker rocks, upstream and downstream from the gaps, are already eroded to the form of wide-open, late mature valleys, or even to the subdued forms of old age. It was interesting to find that in South Africa, as in Pennsylvania, one may still meet with the archaic explanation of such transverse gaps as sudden fractures of the ridge in which they are incised. A modified form of this old view is found in the statement: "The rivers . . . force their drainage through the ridges to the sea." The difficulty with such explanation is, not simply that there is no evidence of sudden fractures, but also that the explanation implies an erroneous understanding of the relation of the maturely open, longitudinal valleys to the narrow, transverse gaps. Explanation by fracture tacitly postulates that the only thing to explain is the gap; and thus implies that the longitudinal valleys and the ridges are, as it were, ready-made features. As a matter of fact, the longitudinal valleys are quite as much the work of erosion as the transverse gaps; and, indeed, the two unlike kinds of valleys are the work of erosion in the same period of time. In such cases the incision of the streams beneath a presumable surface of former peneplanation progressed simultaneously in their

longitudinal as well as in their transverse courses all along their length, though probably at somewhat different rates in different parts. The deepening of the upstream parts of the valleys necessarily waited upon the deepening of the downstream parts; but the widening of the valleys everywhere depended only on the resistance of the rocks in which they were carved; the widening therefore varied greatly from place to place, being much more rapidly accomplished where the streams flowed along belts of weak rocks than where they flowed across belts of resistant rocks. Hence, in such cases as these, we must conceive of the inner longitudinal valley as being deepened about as fast as the transverse gaps were deepened; but while the longitudinal valleys widened with relative rapidity, the transverse gaps are still held narrow by the resistance of the rocks in which they are incised.

This explanation of the watergaps assumes that the present arrangement of longitudinal and transverse drainage had already been developed during the adjustment of the streams to the structure of the district concerned, during the cycle of erosion which ended in the production of the inferred sky-line peneplain already referred to. The location of the transverse members of such a drainage system is not easily accounted for; and no sufficient explanation for this element of the problem has yet been offered for the Cape Colony ranges.

The effect of the Cape Colony ranges in walling off one longitudinal valley or lowland belt from another was very marked. The ranges are by no means unsurmountable; but it would be difficult to construct and to maintain roads over them, and most laborious to use the roads. Hence the great importance of the watergaps as roadways, already reduced to easy grade by natural processes. Common roads and railways repeatedly run through the gaps in gaining access to the interior. The same thing is true in Pennsylvania and Virginia: if our wagon roads are here and there laid over the ridges, they are of long and toilsome ascent and of rough descent. Nearly all traffic from a valley or lowland on one side of a ridge in the Alleghenies to a corresponding district on the other side is by the way of the watergaps, which are, fortunately, rather numerous. Railroads in particular seldom attempt the difficult task of climbing or of tunnelling through a ridge in order to save distance; it is more economical to follow a roundabout course along the naturally-graded waterways.

The finest gap in a ridge of Table mountain sandstone through which our route led us was the gorge of Hex river, by which the

main railway line from Cape Town to the interior highland makes its way through the mountains. This gorge is peculiarly placed along the axis of a pitching syncline which is formed where two monoclinal ridges of Table mountain sandstone come together—one from the east, the other from the north. The pitch of the syncline is to the northeast, but the course of the river is to the southwest. It is, therefore, evidently not a consequent river, for in that case it should flow northeast with the pitch of the syncline; its course has been taken during the progress of the many changes by which the presumably initial consequent drainage has become adjusted to the structure of the region. The gorge is a superb piece of rock-cutting; great ragged walls of bare sandstone enclose it, expressing their determined resistance by standing up in steep crags. Yet the walls are ravined here and there; and the ravines, even though drained only by wet-weather streams, join the floor of the main gorge essentially at grade, thus exhibiting once again the truth of Playfair's law in so far as non-glaciated valleys are concerned, and pointing the moral of the hanging lateral valleys of strongly-glaciated mountains. A broadly-opened subsequent valley-lowland lay outside—southwest—of the gorge; this was eroded, for the most part, on weak rocks that underlie the Table mountain sandstone. Another open valley lay inside—northeast—of the gorge, this being eroded on the weak overlying (Bokkeveld) strata. On ascending the river and entering the interior valley, we followed the base of the southern wing of the pitching syncline for a number of miles eastward; and, on looking back, we could see the other wing stretching away to the northward, where after a few miles it sank down in what our guide, Mr. Rogers, said was a pitching anticline, thus affording still another repetition of Alleghenian topography; for if there is one thing that is characteristic of the Medina ridges in Pennsylvania it is the submissive way in which, after continuing in strong relief for miles and miles, they gradually decline when the axis of their determining anticline pitches down from a sky-line height and gently sinks underground. The geological maps of the Cape Colony ranges indicate that pitching anticlines occur at several points, and also suggest the occurrence of zigzag ridges in some places; but the only approach to that sort of thing that we actually saw on an Appalachian scale was in the turning ridge which Hex river cuts through, as has just been stated; and the zigzags nowhere seem to reach the extraordinary perfection that they attain in the Pennsylvanian Alleghenies.

There is another and a larger relation in which the drainage of

the Cape Colony ranges resembles that of the Alleghenies. In both these ranges the rivers rise in the interior plateau and flow across the belt of folded structures to the sea. It is difficult to conceive of such an arrangement of drainage as consequent on the deformations by which the mountain structures were produced; for at that time the anticlinal crest-lines of the folded belt, as shown in Fig. 2, must have been much higher than the generally undisturbed surface of the interior district, now included in the corresponding plateaus. It is possible to conceive that the through-going rivers are of antecedent origin; but such a suggestion is at the best only a gratuitous hypothesis, with nothing to support it. Indeed, the many changes that the rivers of both these folded mountain systems have undergone, during the adjustment of drainage lines to weak structures, make it very unlikely that any antecedent rivers still remain unchanged since the time preceding the production of the anticlines and synclines. The transverse through-going rivers, of which the Gouritz and the Gamtoos are the chief examples in the Cape Colony ranges, are most plausibly regarded as having been in some way developed during the successive cycles of erosion that the region has suffered; the chief processes in this development being headward erosion and capture, especially during the earlier stages of whatever cycles of erosion the region has witnessed, for then the incision of valleys takes place most rapidly; and especially whenever a tilting of the region has occurred, for at such times the headward erosion by streams that are steepened is greatly accelerated.

It is worth pointing out in this connection that the rivers which cross the Alleghenies from the interior plateau to the Atlantic—namely, the Hudson, Delaware, Susquehanna, Potomac, and James—are all occupants of that central part of the Appalachian system in which the belt of older crystalline rocks, the presumable "oldland" or source of the Appalachian sediments, has been most depressed and encroached upon by the sea — witness the strong overlap of the coastal plain strata on the crystalline belt from New York to Richmond; while farther northeast in New England and southwest in North Carolina, where the belt of older crystalline rocks is wider and higher, there are no transverse rivers corresponding to those of the central district. Indeed, the rivers that rise in the highlands of North Carolina—namely, the New-Kanawha and the Tennessee—still flow northwestward across the plateau, as if thus retaining in a general way the courses given to them by the mountain-making uplift of the region. In South Africa, the rivers which traverse the Cape Colony ranges have now no "oldland"

whatever to encounter; and if any "oldland" ever existed south of the ranges, as has been suggested in a previous paragraph, it has been completely lost by erosion and submergence.

The North-and-South Ridges of Southwestern Cape Colony.—The north-and-south ridges of the Cape Town district, of which the Table mountain range is one, differ from the east-and-west Cape Colony ridges in several important respects, although both are made of the same heavy sandstone formation. The north-and-south ridges are of moderate length, as from ten to fifty miles; while the east-and-west ridges may extend a hundred or more miles, with

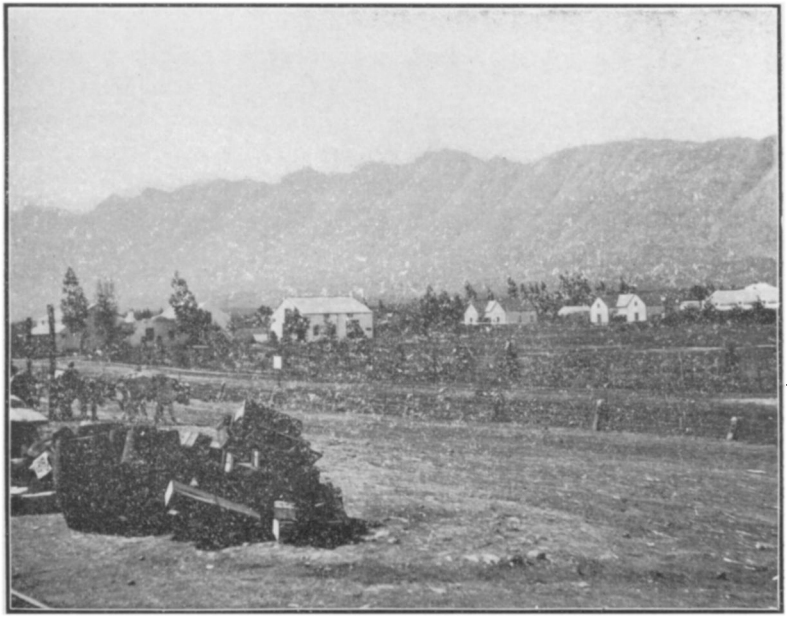


FIG. 11.—VILLAGE NEAR THE DRAKENSTEIN RANGE.

no interruption save a few narrow watergaps. The lowlands of erosion between the north-and-south ridges are broader and smoother than those between the east-and-west ridges; and owing to the shortness of the ridges the broad lowlands are confluent around their ends, thus offering a much larger proportion of surface available for continuous occupation and for easy communication than is the case among the east-and-west ridges. But the chief contrast between the two groups of ridges is in regard to their structure, for several of those now under consideration seem to be of synclinal or downfaulted structure; none that we saw present the regular

anticlinal structure that prevails so persistently in the east and-west ridges. It should be stated, however, that this inference as to the prevailing structure of the north-and-south ridges is not so well grounded as is the statement concerning the anticlinal structure of the others. The inference is indeed based largely on general relations of the north-and-south ridges to the surrounding lowlands of older rocks, rather than on a clear view of stratigraphic succession. The only consistent reason that can be given for the deep erosion of the lowlands and the preservation of strips of Table mountain sandstone in the isolated ridges is that the eroded lowlands represent areas where the once universal cover of the heavy sandstones was relatively elevated, so that when it was once cut through it was actively sapped by the removal of the weaker underlying strata; while the isolated ridges mark areas where the heavy sandstones were relatively depressed—perhaps below the baselevel of an earlier cycle of erosion—and where their erosion was therefore delayed for a longer period.

In consequence of presenting outcrop faces, which break across the stratification of the sandstones, the sides of the north-and-south ridges (Fig. 11) are much more rugged than are the slopes of the east-and-west anticlines, in which the flanks of the ridges may accord rather closely with the bedding planes, and may therefore be of smoother form. It is for this reason, apparently, that a north-and-south range—the southern extension of the Cedarbergen—on the eastern side of the valley of upper Berg river is of so striking and picturesque form, in strong contrast to the even slopes of the Klein Zwartberg. There is, indeed, in some of the north-and-south ridges so ragged a dissection that they may be described as serrate, for their crest-line shows many irregularities in the way of peaks and notches.

The contrast between the different ranges thus pointed out is furthermore of value because it serves, when properly interpreted, to correct a widespread misunderstanding. It is often stated that anticlinal ridges characterize modern mountain systems, while synclinal ridges prevail in ancient and greatly-eroded mountain systems; but it is a mistake to suppose that there is really so simple a relation as is thus implied between structure, time, and form. Another element enters the problem—namely, the attitude of the anticlinal and synclinal structures with respect to the controlling baselevel; and until this is taken into account no comprehensive explanation of the problem can be reached. Here, as in the various other features already considered, the similarity of the Cape

Colony ranges and the Alleghenies is again very marked, and as the latter are the more familiar, they will be first briefly considered in this respect, by way of introduction to the South African examples.

The Alleghenies are frequently instanced in support of the above-stated generalization as to the prevalence of synclinal ridges in ancient and greatly-eroded mountain systems, but, as a matter of fact, the Alleghenies give the generalization no real support.* The mountains of Pennsylvania are for the most part not synclinal ridges, although such ridges do predominate for a local reason in a certain part of the State—namely, in the anthracite district of the upper Schuylkill river. The commonest type of Allegheny ridge in Pennsylvania is the monocline, or limb of a wide anticline or syncline; the next commonest, judging by measured length of occurrence on the maps of the State Survey, is the anticlinal ridge, of which Tuscarora mountain, in the southern-central part of the State, is a superb example; and synclinal ridges are really less common than either of the other types.

As to the theory of the case, the essential elements on which the form of eroded mountains depends are not simply structure and time, as the generalization above quoted would imply, but structure, baselevel, and time. In a long-eroded mountain system of folded strata all the residual reliefs will be of hard strata, whether the hard strata are synclines or anticlines or monoclines; no elevations of weak strata, whatever their structure, can then survive. At such a stage of erosion it is truly necessary that a syncline whose hard strata stand somewhat above baselevel should form a ridge, as at *S*, Fig. 12; for the hard strata along the synclinal axis will then be left in relief by the erosion of the once higher parts in the adjoining anticlines, and by the peneplanation of the underlying weaker strata in the subsequent lowlands. It is, however, equally natural that an anticline whose hard strata stand in a similar attitude above baselevel may also stand up as a ridge, as at *A*, Fig. 12. Time is, therefore, not alone in control; relation of structure to baselevel is quite as important. In Pennsylvania it is precisely the above-stated relation of structure and baselevel which determines the occurrence of the various anticlinal and synclinal ridges. Inasmuch as the axes of the folds are not horizontal, but rise and fall gently when followed along their trend, synclinal ridges *B*, *C*, will be developed wherever synclines of hard sandstone rise somewhat above baselevel, while the adjoining anticlines of the same strata are high up in the

* See A. P. Chittenden, Mountain Structures of Pennsylvania: BULLETIN *Am. Geog. Soc.*, *1897*, *No. 2*, *175-180*.

air; an anticlinal ridge, *R*, will survive in another district where an anticline of sandstone stands somewhat above baselevel, while the adjoining synclines of the same strata are deep underground; and monoclinal ridges of Medina will connect these apparently incompatible forms through the intermediate district.

The same control of form by structure, baselevel, and time is illustrated by the distribution of anticlinal and synclinal ridges in South Africa. The ridges of the east and west Cape Colony ranges are of anticlinal structure, as in Fig. 2, because it happens that the resistant folds of Table mountain sandstone repeatedly rise effectively above baselevel in that district; the ridges stand forth to-day because the weaker overlying Bokkeveld strata have been worn away from above and alongside of them. This is simply and entirely because these resistant sandstones repeatedly rise in anticlinal

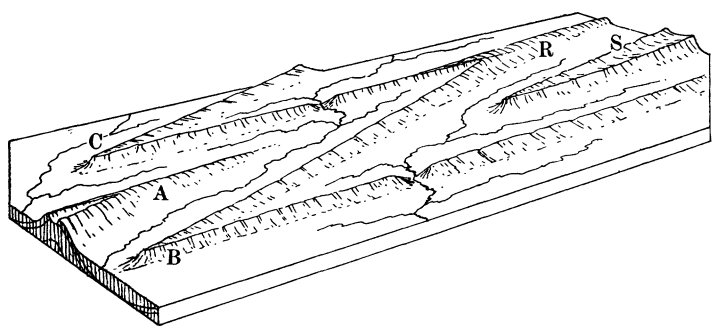


FIG. 12.—DIAGRAM OF ANTICLINAL, SYNCLINAL AND MONOCLINAL RIDGES.

structure to a height, with respect to present baselevel, appropriate for the formation of strong ridges, just as many anticlines of strong sandstone rise effectively above baselevel in central Pennsylvania. The north-and-south ridges of the Cape Town district are, on the other hand, synclines (or down-faulted masses) of Table mountain sandstone, because it is only those relatively depressed parts of the originally universal sandstone cover that now stand at a moderate enough altitude above baselevel to have escaped destruction; the corresponding anticlines are all long since consumed.

It follows from this that the general attitude of the Table mountain sandstone must be higher in the Cape Town or south-western district than farthest east; this inference is confirmed by the exposure in the lowlands between the north-and-south ridges of large areas of the underlying Malmesbury slates, which are hardly seen among the east-and-west ranges. There can, conse-

quently, be no doubt that the contrast between these mountains of the same sandstone, but of contrasted structures, is not dependent on the age of the mountains, but simply on the attitude of the mountain-making sandstones with respect to the controlling base-level.

Contrasts of Climate between the Alleghenies and the Cape Colony Ranges.—It happened that immediately before sailing from New York, July 15, 1905, on my way to South Africa, I had spent a week in central Pennsylvania with the members of an inter-collegiate Appalachian summer course in geology; and the characteristic features of that picturesque district were therefore fresh in my memory. Little more than a month later I was in the Cape Colony ranges, and the repetition there of many structures and forms that had been seen at home was very manifest. But striking as were the many points of similarity between the two mountain systems, there was an element of difference that was still more impressive. This was the contrast as to vegetation and habitability, dependent on climate. The difference of temperature experienced in the two regions was not significant, for this was due to a difference of season; the weather during the week in Pennsylvania had been a severe example of the sweltering heat of our northern summer, while the weather that we had in the Karroo was agreeably mild by day and somewhat below freezing at night, appropriate to the end of the southern winter. The significant contrast was that between the sufficient rainfall of the eastern United States and the insufficient rainfall of South Africa.

The southern coast of South Africa receives a moderate rainfall, but it is a rainfall of sub-tropical type, and falls chiefly during the winter months; it is, therefore, of less value to vegetation than a similar fall would be in summer. The highland of the Veld also has a rainfall of medium value, about 30 inches a year, increasing eastward, and there the greatest part of the fall is in summer. But the Karroo, or district of the inner ranges and adjoining margin of the highland, has a somewhat smaller rainfall than either the coastal border or the interior plateau; it is an arid region, unattractive to settlement. The Medina sandstone which makes most of the Pennsylvania ridges is apparently as resistant a rock as the Table mountain sandstone, the chief ridge-maker of South Africa; but the Pennsylvania ridges are beautifully forested, and between the trees there is an abundant growth of shrubs and smaller plants. The Cape Colony ridges are for the most part entirely wanting in trees; even bushes are scanty on the barren sandstones, and the surface

presents a large amount of bare rock and soil. The valleys among the Allegheny ridges are fertile, particularly where the soil is derived from limestones; they are all well occupied by an agricultural and manufacturing community: in those districts where the coal-beds have not been removed by erosion a dense population is gathered around the numerous productive mines. The valleys that we saw between the Cape Colony ranges had a pleasing and hospitable appearance where they are not too far inland to receive sufficient rainfall; those which we crossed on the way inland from Cape Town were occupied by occasional villages of thrifty appearance, with fields of repaying fertility around them and ragged mountains in the background, as in Fig. 11; but in the interior country the lowlands were for the most part empty and desolate. Even on the railway line villages were small and far apart; roads led out from them across uninhabited tracts for miles and miles. The village of Matjesfontein, shown in Fig. 8, gives an over-encouraging idea of the possibilities of the Karroo district; for this neat settlement is largely the work of a wealthy contractor, who finds his pleasure in overcoming the adverse conditions of a dry climate at whatever cost. The extensive view that we enjoyed from a knob of the Witteberg ridges over a broad longitudinal valley revealed only one house. Even along the streams there was no considerable amount of irrigation, because the volume of water to be had in the dry season is so small and so fluctuating. We saw flocks of sheep and goats, and marvelled that they could find subsistence where herbage was so scanty. Ostrich-farming seemed more appropriate to this dry country; but even ostrich farms were few and far between in the upper valley of Buffels river near Laingsburg. We often turned from the depressing effects of this desolate landscape to look at the plants that had learned to grow there, and heard with interest from the botanical members of the party accounts of the peculiar devices by which vegetation was enabled to survive in the dry country.

The same absence of tree growth and the same great extent of unoccupied country prevail over the highland of the Veld, until far towards the north we come upon the open forest of ungraceful trees which gives the name of Bushveld to that region. South of this area of natural forest the only trees are pines from the Mediterranean, which are now abundant around Cape Town, and gums and wattles (eucalyptus and acacias) from Australia: but this statement does not apply to the east coast, where there is more rain and abundant tree growth.

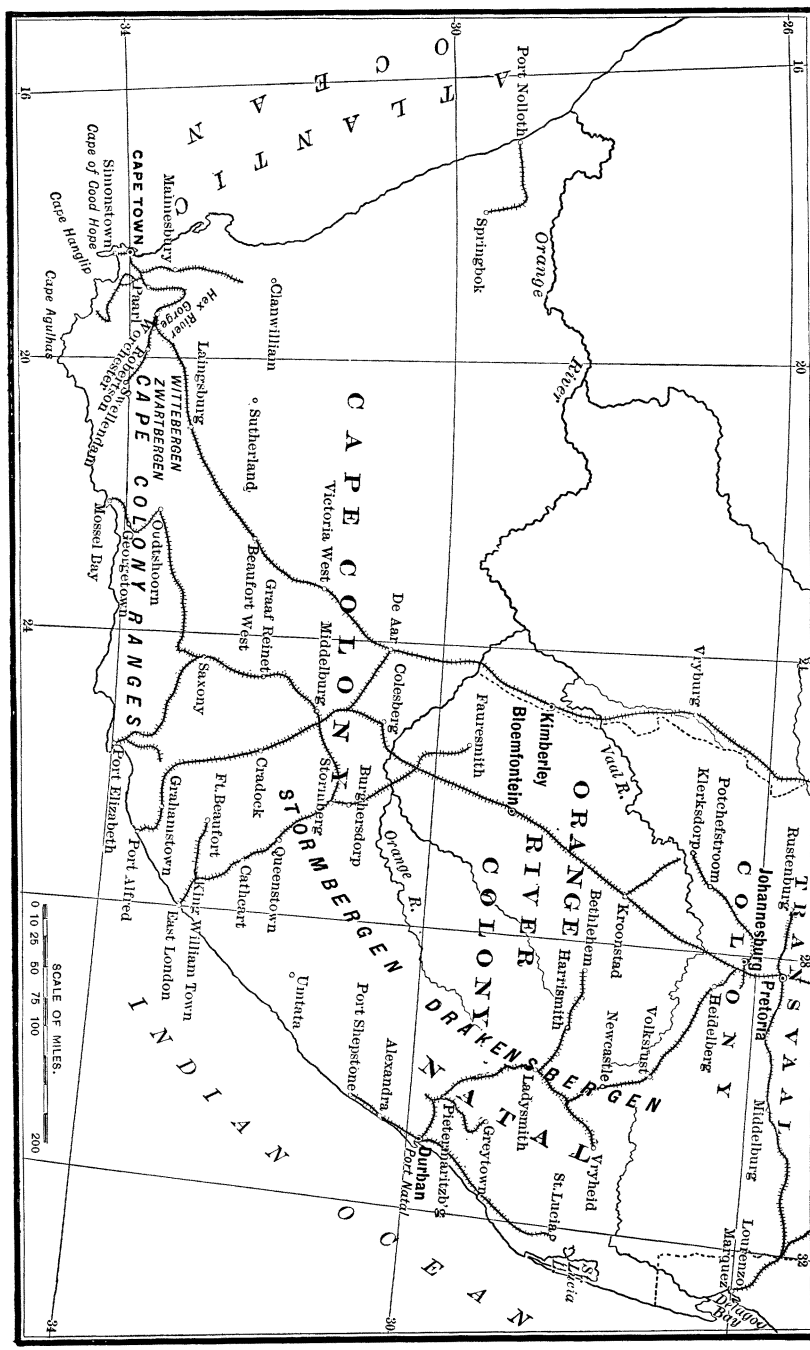


FIG. 13.—OUTLINE MAP OF SOUTH AFRICA.

The Veld and its people reminded us often of what may be seen in our open western country, all the more when coming upon the great mining camps of Johannesburg and Kimberley; but with the difference that in South Africa the labouring population is largely made up of native blacks, now supplemented on the Rand by the fifty thousand Chinese whose importation has caused so much feeling in England. Even to us, as passing strangers, it was evident enough that the long-lasting problem of the native races was the greatest which the Europeans in South Africa have to face—far greater than the temporary misunderstandings that caused, and that still in a measure follow, the Boer war; greater than the difficulties due to lack of rainfall, and to the absence of lofty mountains and of the perennial streams that they would supply; greater than the trouble over rinderpest and other diseases of livestock. In a generation or two the Boers and the English will undoubtedly come to a sufficient understanding, and live together with no more enmity than that of political parties in a self-governing colony; diseases of cattle will be largely controlled by scientific treatment; wherever water supply is available it will be utilized in irrigation, and where water cannot be obtained much of the open country will serve as pasture-ground for wandering flocks. But the problem of the native races is long lasting; and its just settlement will call for no small degree of calmness and wisdom on the part of the Colonial Government—a calmness that shall withstand even the worries arising from headstrong action on the part of the occasional irresponsible and vulgar-minded whites, and a wisdom that shall commend itself even to the ignorant blacks.

It was very profitable to see on the Great Excursion those features of South Africa which repeated physiographic features well known at home, and even more profitable to gain some appreciation of the huge difficulties that the people of another part of the world have to contend with, for thus our sympathy with the Southern Colonies comes to have a sociological as well as a physiographic basis.

Fig. 1. A glaciated ledge of diabase, near Riverton, on the Vaal river, north of Kimberley, Cape Colony. This ledge has been denuded of its cover of Dwyka tillite in recent times. The glacial action by which it was rounded and striated was of Permian date.*

Fig. 2. Diagrammatic section of the Cape Colony ranges, looking east. The oldest rocks, inferred here from outcrops farther

* This figure is from a photograph lately received from Prof. Young of Johannesburg. The other photographic views in this article are from negatives by the author.

west, are Malmesbury (Archæan?) slates and intrusive granites; then follow the heavy Table mountain sandstones (dotted), the marine Bokkeveld (Devonian) series, the Witteberg sandstones (dotted), the Dwyka glacial tillite, and (on the left) the Ecca, Beaufort and Stormberg series of the Karroo system (unshaded) with dikes and sheets of dolerite.

Fig. 3. The peneplain of the Veld, near Volksrust, eastern Transvaal. Water is locally ponded in the deep channel of a stream.

Fig. 4. Hlobani, a dolerite mesa, surmounting the Veld in the Vryheit district, Natal. Ant hills in the foreground. A Zulu Kraal (village) barely perceptible in the middle distance, directly above the nearer ant-hill. On this mesa, Col. Evelyn Wood, assisted by Piet Uys, a Boer, led an attack against the Zulus in 1879.

Fig. 5. Majuba hill, a residual eminence rising over the peneplain of the Veld on its eastern border, in the district of Vryheit, Natal. It was on this hill that Sir George Colley and many of his men were killed in a disastrous fight with the Boers, February 26–27, 1881.

Fig. 6. The open pit of the Kimberley mine, Kimberley. The upper sloping walls consist of the relatively weak Kimberley (Ecca?) shales, about 200 feet thick; the shales are covered with a sheet of diabase; at their base comes the Dwyka tillite, here only a few feet thick. The vertical walls show the shape and size of the "pipe" of diamond-bearing "blue ground"; the walls consist of diabase for about 400 feet, then of quartzite and quartzitic shales for some 700 feet, below which follows a great depth of quartz porphyry. The open shaft is 1,500 feet deep; less than half its depth is here shown. The mine is continued by shafts downward for another 1,000 feet.

Fig. 7. A group of small Matopos or weathered granite knobs, near Bulawayo, Rhodesia. The foreground is an arm of the peneplain which is hereabouts developed on disordered schists.

Fig. 8. Matjesfontein, an exceptionally neat village in the Karroo district, Cape Colony, a short distance west of Laingsburg. In the background (south), the Witteberg ridge is of anticlinal structure, with steep dips and overthrusts on the near side. The foreground is occupied by Dwyka tillite. The structural location of this view is at *A*, Fig. 2.

Fig. 9. Ideal diagram, representing four stages of erosion on a series of folded strata. The background shows the effect of folding without erosion, with consequent ridges and valleys. The second block shows a small amount of erosion in the consequent synclinal valleys, while the crests of the anticlinal arches are breached and converted into longitudinal subsequent valleys. In the third block the anticlinal valleys have been greatly enlarged and deepened in weak strata, so that the original synclinal valleys are converted into residual synclinal ridges. The fourth block

(foreground) exhibits a stage of erosion after the synclinal mountains have been removed, and replaced by resequent synclinal valleys; while the anticlinal subsequent valleys of the second stage are here replaced by resequent anticlinal ridges.

Fig. 10. A serrated monoclinal ridge of Witteberg sandstone, near Buffels river gorge, looking southwest. The structural location of this ridge is indicated at *D*, Fig. 2.

Fig. 11. Drakenstein ridge, inland from Cape Town, looking northeast.

Fig. 12. Diagram of anticlinal, synclinal and monoclinal ridges, formed by extensive erosion of folded strata, the axes of the folds pitching gently to the right.

Fig. 13. Outline map of South Africa. Nearly all the localities mentioned in the text are here indicated.

GEOGRAPHICAL RECORD.

AFRICA.

DETERMINING LONGITUDES IN AFRICA BY TELEGRAPH.—Captain R. Ommanney, R. E., and Captain G. F. Evans, R. E., returned to England at the end of June on completion of the telegraphic longitude work for which they were sent to North Nigeria last autumn. Starting at Lagos in the middle of November, 1905, the expedition worked up the telegraphic line *via* Jebba and Lokoja, and then along the line which goes through Zunguru and Zaria to Kano. Working eastwards, Leri and Bauchi were fixed, and on the return journey the telegraph line along the River Benue was used to determine the positions of Ibi, Keffi, and Loko. In all, the longitudes of fifteen important towns in Nigeria were determined with reference to Lagos, the longitude of which had already been fixed by cable from Cape Town. The mission involved a march of about 2,000 miles, and much arduous work.—*Scott. Geog. Mag.*, No. 8, 1906.

RUWENZORI AND THE SOURCES OF THE NILE.—In the paper which Mr. Douglass W. Freshfield read before the Alpine Club on his journey to Ruwenzori (*Alpine Journal*, No. 173) he said that if he were to go again to this Central African range, he should make every effort to get to the top soon after dawn, before the clouds concealed the view of the Nile sources. He thinks this view would be unique, with both Victoria and Albert Nyanza in sight and embracing practically the whole region of the Nile sources. It is probable that Ruwenzori may be frequently visited in the coming years. The Nile route to Uganda already opened will very soon be greatly improved and quickened, and before long travellers will go down the Red Sea and return by the Nile. Ruwenzori is a fortnight's march from Lake Victoria and about a week's from Lake Albert. A four months' winter tour may suffice for the round, including a visit to the mountain.

THE NATAL GOVERNMENT MUSEUM.—Natal has just issued its first Report (for 1904) of the Museum at Pietermaritzburg. The volume of 185 pp. is